3.3 MARINE BENTHIC HABITATS, INVERTEBRATES, AND FISHES

Marine biological resources on and surrounding the shell mounds include soft- and hard-bottom (benthic) habitats and communities of invertebrates, fishes, and marine wildlife (seabirds, turtles, and marine mammals). This section addresses how the different Program Alternatives would affect benthic habitats and associated invertebrate and fish communities. Section 3.4 addresses impacts to marine wildlife; Section 3.5 addresses impacts to commercial and recreational fishing activities.

3.3.1 Environmental Setting

The marine biological resources within the Santa Barbara Channel (Channel) have been relatively well studied. Trawl and gill net survey data, sediment grab samples, remotely operated vehicle (ROV), and diver observations along the mainland shelf of the Channel provide a good characterization of the epibiota (plants or animals that live on the surface), infauna (animals that live within the sediments), and ichthyofauna (fish species) that typify the various habitat types. For this environmental analysis, the project "region" is defined as the area within a 0.5-mile (0.8 km) radius around each of the shell mounds; the project "site" is each of the shell mounds.

Within the region, Jones (1969, cited in Chambers Group 1988) states that the seafloor habitat in water depths from approximately 60 to 150 feet (18 to 46 m) is generally sedimentary. Jones also indicates that the nearshore (to the 3-nm State limit) infauna of the Santa Barbara Shelf, and along most of the southern California mainland, is characterized by two communities, named for their dominant species: (1) a tube-building worm, *Diopatra ornata,* in shallow depths (e.g., less than about 50 feet [15 m]) and (2) a brittle seastar and clam (*Amphiodia urtica* and *Cyclocardia* (*Cardita*) *ventricosa*, respectively) at depths greater than about 100 feet (30 m).

In water depths up to 330 feet (100 m) off the Summerland-Carpinteria coastline, the infauna has been characterized by two communities: (1) an echiuroid worm (*Listriolobus peloides*) historically dominated the infauna inshore to approximately 150 feet (46 m) water depths; and (2) the above-noted *Amphiodia-Cyclocardia (Cardita*) community characterizes sedimentary habitats further offshore (Dames & Moore 1980, citing Jones 1969). Thompson et al. (1992) note that *Listriolobus* has since declined in many areas of the Southern California Bight, such that the polychaete *Spiophanes missionensis* is second in numerical abundance behind *Amphiodia*. Macroepifauna within these water depths is typified by sea pens (*Stylatula elongata*), sea cucumbers (*Parastichopus* spp.), and sand seastars (*Astropecten* spp.). Chambers Group (1988) states that deeper water rock substrata are limited, but where present, predominantly support anemones, including *Corynactis californica* and *Metridium senile*, and solitary corals (*Caryophyllia* spp., *Coenocyathus bowersi*, and *Paracyathus stearnsi*). Kelp beds and associated fish and invertebrate communities are generally found in water depths of 60 feet (18 m) or less along the mainland shelf of the Channel (Chambers Group 1994).

Summaries of the habitats and associated marine biota found in water depths within which the shell mounds are located (95 to 150 feet [29 to 46 m]) and/or historical site-specific marine biological data are provided in several documents (e.g., City of Oxnard and U.S. Geological Survey 1980, CSLC 1995, and de Wit 1999 and 2001). Most of the pre-1995 studies focused on the epibiota and ichthyofauna associated with the platform structures, while later surveys were conducted immediately prior to and shortly after those structures were removed. For example, Bascom et al. (1976) summarize several marine biological studies of Platforms Hilda and Hazel, including results from a 1975 survey,[1] and report that animals associated with "the cuttings piles" were similar to those on the structure. The powder puff anemone (*Metridium senile*) was common on those features, and the yellow rock crab (*Cancer anthonyi*), bat stars (*Asterina [=Patiria] miniata*), and cucumbers (*Parastichopus* spp.) "inhabited the nearby bottom." Analyses of the sediment samples around Platform Hazel indicated that filter-feeding polychaete worms dominated the infauna near the platform and dense beds of the tube-building worm *Diopatra ornata* were observed on the "debris immediately surrounding Hazel." Down current (west-northwest) of the platform, another filter-feeding polychaete worm *Trochochaeta franciscanum* replaced *D. ornata*.

3.3.1.1 Shell Mound Communities

Comparisons of the general biological characteristics of the shell mounds before and after platform removal indicate that the habitat value for most of the organisms found prior to platform removal has decreased, as has the abundance of most taxa. When the platforms were in place, they and the shell mounds supported a relatively rich and diverse epibiota and fish community; however, with the removal of the vertical structures in 1996, both diversity and species richness decreased substantially (de Wit 2001). These comparisons are discussed below.

Epibiota/Infauna

Results of macroinvertebrate sampling on several shell mounds in the Channel indicated that echinoderms and two of the four species of mollusks studied (*Megathura crenulata* and *Cypraea spadicea*) were generally larger and more abundant on shell mounds beneath existing platforms than on those without platforms (Bomkamp et al. 2001). Somewhat in contrast to these mollusks, but similar to observations from several studies by de Wit (see below), Bomkamp et al. found that sea cucumbers (*Parastichopus californicus*) and bat stars (*Asterina* [=*Patiria*] *miniata*) were more abundant on shell mounds without platforms but predatory sea stars (*Pisaster* spp.) were "virtually absent from mounds without platforms." The differences in sea stars may be caused by the relative decrease in mussels used as important prey items by *Pisaster*. Bomkamp's study found similar numbers of brown rock crabs (*Cancer antennarius*) on shell mounds with and without platforms. The results of that study

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1 The 1975 survey, conducted from April through September, included biological observations at and around the platforms and at nearby sedimentary and hard bottom control sites; sediment samples taken near the platforms and at stations radiating out in the four major compass directions from the platforms; tissue samples from organisms collected at the platforms and at various control stations; and current and water quality data from various locations near Platform Hilda.

suggest “platform removal has the greatest effect on higher trophic levels,” including the mollusks and *Pisaster*.

De Wit (1996) surveyed the marine biota associated with the 4H Platforms and shell mounds prior to platform removal. These results indicated that anemones (*Metridium senile* and *Corynactis californica*), three species of sea stars (*Pisaster giganteus, P. ochraceus*, and bat stars), and at least six species of fish (blacksmith, rubberlip and pile surfperch, olive and brown rockfish, and kelp bass) were common at and around the platforms. Studies dating back to the 1960s (identified in de Wit 1996) indicated that 47 species of fish and 40 species of invertebrates have been observed on and around the submerged portions of Platforms Hazel and Hilda.

In 1998, two years after platform removal, de Wit (1999) surveyed the four shell mounds with cameras mounted on a ROV, and documented three relatively distinct habitats: (1) perimeter habitat comprising sediment and partially-buried shells; (2) mixed bottom of sandy sediment and shell bits; and (3) shell habitat made up of sediment-covered and “clean” shells. In a later survey, de Wit (2001) found the shell mounds comprised similar habitats as those reported in the 1998 study; however, several pipelines were noted around the perimeter of the shell mounds and the stub of a single platform leg was observed at the Hazel shell mound. The stub is 5 to 6 feet (1.5 to 1.8 m) in diameter and projects about 12 feet (3.7 m) above the shell mound. De Wit (2001) also reported that sediment cover on the shell mounds had increased since 1998, and that numerous depressions up to 5 feet (1.5 m) deep were observed on the surface of three mounds where the legs of Platforms Heidi, Hilda, and Hope were removed, in contrast to the above-noted appearance of the Hazel shell mound (see Figure 1-3). All of the mounds show additional pockmarks and scarring, which could be a result of the subsidence of shell mound materials, erosion by currents, and/or scarring by anchors or fishing gear.

While the species composition of shell mound-associated macroepibiota and fish reported in de Wit (2001) was similar to that found in 1998, the relative abundance of rockfish and the bat star (*A. miniata*), the dominant macroepifaunal species, had decreased from those reported in the earlier study. Small specimens of a gorgonian coral, *Lophogorgia chilensis*, were present on the shell material, but were more common on the exposed concrete stub. A solitary coral, *Paracyathus stearnsi*, was present to common on the exposed pipelines. Analysis of diver-collected samples from the Hazel and Hilda shell mounds revealed that mollusks (11 taxa), polychaete worms (2 taxa), and arthropods (4 taxa, including juvenile brown and red rock crabs, *Cancer productus* and *C. antennarius*, respectively) were present within the shell material matrix (de Wit 1999). De Wit (1996) noted the presence of brittle stars within the shell mounds during the ROV and diver surveys of the platforms prior to their removal. MEC (2002) conducted box core sampling of the mounds; however, taxonomic analyses were not completed on those samples.

Table 3.3-1 lists the relative abundance of the invertebrate and fish taxa observed on the shell mounds two and four years after the platforms had been removed. Data provided in this table indicate that the macroepibiota associated with the exposed leg stub at the Hazel shell mound was substantially different than that on the shell material.

Table 3.3-1. Estimated Relative Abundance (estimated number/m^2) of Invertebrates and Fish Observed on Shell Mounds (1998 and 2000)[2]

	Platform Hazel				*Platform Hilda*		*Platform Heidi*		*Platform Hope*	
	Shell Mound		Exposed Leg Stub		Shell Mound		Shell Mound		Shell Mound	
Taxa	*1998*	*2000*	*1998*	*2000*	*1998*	*2000*	*1998*	*2000*	*1998*	*2000*
Cndarians										
Lophogorgia chilensis	<0.2	<0.1[a]	NA[b]	7.0	0.2	0.1	0.0	<0.1	0.0	<0.1
Muricea sp.	0.0	<0.1	NA	1.5	0.0	0.0	0.0	0.0	0.0	0.0
Paracyathus stearnsii	P	P[c]	NA	0.0	0.0	0.0	P	0.0	P-C	0.0
Cerianthid anemones[d]	0.0	0.2	NA	NA	0.0	0.1	0.0	<0.1	0.0	<0.1
Corynactis californica	0.0	P	NA	P-C	0.0	0. 0	0.0	0.0	0.0	0.0
Metridium senile	P	0.0	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sea pens	0.0	0.2	NA	NA	0.0	0.1	0.0	0.3	0.0	0.3
Mollusks										
Cypraea spadicea	0.0	<0.1	NA	0.0	0.0	<0.1	0.0	0.0	0.0	0.0
Unid. octopus	P	<0.1	NA	NA	0.0	<0.1	0.0	<0.1	0.0	<0.1
Kelletia kelletii	0.0	0.0	NA	0.0	0.0	0.0	<0.1	<0.1	<0.1	0.0
Arthropods										
Cancer sp.	0.0	<0.1	NA	0.0	0.0	0.0	<0.1	0.0	0.0	0.0
Echinoderms										
Asterina miniata	0.1	0.1	NA	1.8	0.8	0.2	1.3	0.8	1.4	1.8
Pisaster brevispinus	0.0	0.0	NA	0.3	0.0	0.0	0.1	0.0	0.0	<0.1
P. giganteus	<0.1	<0.1	NA	0.0	0.1	0.0	<0.1	<0.1	<0.1	0.0
Parastichopus sp.	0.2	<0.1	NA	0.6	0.0	<0.1	0.0	<0.1	0.0	0.2
Fish										
Coryphopterus nicholsii	0.0	0.0	NA	0.0	0.0	0.0	<0.1	<0.1	<0.1	0.1
Paralabrax nebulifer	0.0	0.0	NA	0.0	0.0	0.0	0.0	0.0	P	0.0
Pimetoletopon pulchrum (juv)	0.0	0.0	NA	0.0	0.0	0.0	0.0	0.0	P	0.0
cf Rathbunella sp.	0.0	0.0	NA	0.0	0.0	0.0	0.0	<0.1	0.0	0.0
Sebastes auriculatus	0.0	<0.1	NA	0.0	0.0	0.0	0.0	<0.1	0.0	<0.1
S. dallii (juveniles)	0.0	0.0	NA	P	0.3	0.0	0.0	0.0	0.3	0.0
Sebastes spp.	0.0	<0.1	NA	0.3	0.0	<0.1	0.0	<0.1	0.0	<0.1
Zalembius rosaceus	0.0	<0.1	NA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unidentified fish	0.0	<0.1	NA	0.3	0.0	<0.1	0.0	<0.1	0.0	0.1

For example, *A. miniata* were 18 times more abundant (est. 1.8/m^2 vs. 0.1/m^2) on that structure than on the shells, while the combined abundance of two colonial gorgonian corals (*L. chilensis* and *Muricea* sp.) was approximately 40 times higher (est. 8.5/m^2 vs. <0.2/m^2) on the leg stub. That structure and the shell material immediately around its base also supported the only aggregations of the strawberry anemone (*Corynactis californica*) observed on the four shell mounds (de Wit 2001). Although common on the shell mounds when the platforms were in place, no powder-puff anemones (*M. senile*) were observed in 2000.

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2 HOW TO USE THIS TABLE: The table shows, for example, that the estimated relative abundance of *Asterina miniata* (bat star) at Platform Hilda was 0.8 individuals/m^2 in 1998 and 0.2 individuals/m^2 in 2000. Similarly, de Wit estimated the relative abundance of *S. dallii* (juvenile calico rockfish) at Platform Hope to be 0.3/m^2 in 1998 and 0.0/m^2 in 2000.

The most recent observational data documenting epifauna on the shell mounds suggest a progressive decrease in diversity and abundance of the macrofauna compared to periods when the platform structures were in place. The mounds, comprising a mixture of sediment and shell talus, provide habitat for some macroepibiota (e.g., *A. miniata* and *Parastichopus* spp.). Results of the limited sampling of infauna indicate some juvenile mollusks, polychaete worms, and arthropods live within the shell layer. In addition, the surface characteristics of the shell mounds differ from the natural seafloor, thus providing more attachment substrate for epifauna than occurs on natural sedimentary habitat. Sea pens and cerianthid anemones are common on the fine-grain sediments surrounding the shell mound sites, but were not observed on the shell material. Both species were present in areas where the shell material was covered with sediment around the perimeter of the mounds; however, only cerianthid anemones were observed in sediment-covered portions of the elevated portions of the shell mounds.

Ichthyofauna

Love et al. (1999) report the results from a fish survey of seven deep-water (213 to 734 feet [65 to 224 m]) oil and gas platforms and their respective shell mounds in the Channel and the Santa Maria Basin. That study indicates that rockfishes accounted for 18 of the 34 fish taxa observed on the shell mounds. Love et al. (1999) also reported several other species of schooling fish (i.e., shiner surfperch, Pacific sardines, and the northern anchovy) over the shell mound and in the water column adjacent to some platforms. It was suggested, however, that those species are highly mobile and perhaps not representative of shell mound fauna. The commonly observed shell mound-associated schooling fishes were halfbanded rockfish (*Sebastes semicinctus*) and unidentified young-of-the-year rockfish that were observed from 3 to 10 feet (1 to 3 m) above the shell mounds or “very close to the shell-covered substratum.” Based on one year of observations, Love et al. (1999) suggest that the shell mound fish community is not unique, but is considered an integral part of the “platform system” and the shell mound fish assemblage appears to be more similar to that found on its associated platform than to other mounds.

Carlisle et al. (1964) surveyed the fishes associated with Platform Hazel for 29 months following its installation in 1958. Based on that report and later surveys reported in SCCWRP (1975), Mearns and Moore (1976), and Bascom et al. (1976), surfperch and rockfish comprised the most regularly observed taxa, with olive, blue, and brown rockfish (*Sebastes serranoides, S. mystinus* and *S. auriculatus,* respectively), white and pile perch (*Phanerodon furcatus* and *Damalichthys vacca*), and kelp bass (*Paralabrax clathratus*) as the most common species. MBC (1987) reported that fish abundance at Hazel and Hilda was not uniform, but was greatest in water depths of 50 to 60 feet (15 to 18 m). No quantitative data are available on fishes associated with the shell mounds at any of the 4H sites prior to platform removal.

Observations made during an ROV survey prior to removal of the submerged portions of the platforms (de Wit 1996) found that the fish fauna around the platforms varied with depth and comprised a relatively diverse community. Commonly observed species in shallow-water (15 feet [5 m]) included unidentified atherinids (probably jack and/or top smelt), blacksmith (*Chromis punctipinnis*), and rubberlip surfperch (*Racochilus toxotes*). Deeper-water portions of the platforms supported a fish community similar to that reported in earlier studies, comprising olive and brown rockfish, pile perch, kelp bass, and an occasional lingcod (*Ophiodon elongatus*) and cabezon (*Scorpaenicthys marmoratus*). As for the earlier studies, the survey was not designed to evaluate the mound areas specifically so no fish data related directly to the shell mounds are available.

Prior to cutting and removing the platforms, the upper 60 feet of the submerged portion of the platform was removed. A study to assess impacts of the detonation of underwater explosives used to cut the platform jacket legs at Hilda, Heidi, and Hope was conducted in July 1996. The composition and relative abundance of fish collected on the sea surface following detonation of a total of 74 subsurface charges is presented in Table 3.3-2.

As shown in Table 3.3-2, a total of 8,930 fishes representing 13 families were collected following the detonations. The most abundant taxon collected was the northern anchovy (*Engraulis mordax*), which accounted for 74 percent (6,603 individuals) of the total.[3] Croakers, including the white croaker (*Genyonemus lineatus*) and the queenfish (*Seriphus politus*), contributed 11 percent (993) of the total, while the third most abundant family, surfperches, comprised 8 percent (754) of the total. Combined, the nine species within these families accounted for 94 percent (8,350) of the total individuals collected. Although some fish were consumed by birds before they could be collected, that loss is estimated to be less than 5 percent of the total. The largest individual fish collected was a 33.5-inch (standard length) barracuda (*Sphyraena argentea*), and the smallest was a 2.25-inch anchovy. Except for the 17 barracuda, 1 rockfish, 1 Pacific mackerel, and 1 rubberlip surfperch, all collected fish were less than 12 inches in standard length.

Data collected during the 4H Decommissioning Project suggest that the composition of the fish associated with the “shortened” platforms (i.e., minus the upper 60 feet of the submerged portion of the platforms) differed from historical records. While the composition and abundance of fish shown in Table 3.3-2 include only individuals that were floating on the surface, the data suggest that the ichthyofauna was dominated by pelagic (near surface and surface-dwelling) taxa, such as anchovies, and other species not generally associated with high-relief solid substrate (e.g., mackerel and barracuda). Gotshall (1989) describes the northern anchovy as pelagic and occurring in large, tightly packed schools. The relatively large number of individuals of this species that were collected following detonations is consistent with their habit of schooling as described by

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3 According to J. Gall, a commercial bait fisher from Santa Barbara (pers. comm. 1996), a bait-net scoop of anchovies used by a commercial sportfishing boat contains approximately 400 fish, equaling about 15 pounds. Gall also indicated that a commercial sportfishing boat usually takes 20 to 30 scoops (8,000 to 12,000 fish) per full-day fishing trip. Therefore, the anchovies collected during the ten days of demolition activities during the 4H Decommissioning Project represented 50 to 60 percent of a 1-day fishing trip bait requirement for one commercial sportfishing boat out of Santa Barbara.

Gotshall. Mid-water and sedimentary habitat-associated taxa (e.g., queenfish and white croaker) also contributed relatively larger percentages of the total. Maxwell (1975) states that white croakers "usually occur in loose schools over sandy bottom" and that queenfish "…are commonly found in shallow waters over sandy bottoms…and frequently in small dense schools in shady areas such as piers or kelp beds." In contrast, blacksmith, observed commonly during pre-removal surveys, accounted for just under 3 percent of the total fish collected during the post-detonation survey, and rockfish, historically one of the most abundant "groups" of fish associated with the platforms, accounted for only 1.2 percent of the total (110 individuals).

Table 3.3-2. Composition of Fish Collected on the Sea Surface Following Underwater Detonations at Platforms Hilda, Heidi, and Hope

Scientific Name	*Common Name*	*Total Number Collected*	*Percent of Total Fish*
Engraulis mordax	Northern anchovy	6,603	73.9
Genyonemus lineatus	White croaker	654	7.3
Seriphus politus	Queenfish	339	3.8
Phanerodon furcatus	White surfperch	302	3.4
Chromis puntipinnis	Blacksmith	262	2.9
Zalembius rosaceus	Pink surfperch	192	2.2
Sarinops sagax caeruleus	Pacific sardine	133	1.5
Phanerodon atripes	Sharpnose surfperch	127	1.4
Damalicthys vacca	Pile surfperch	72	0.8
Rhacochilus toxotes	Rubberlip surfperch	35	0.4
Cymatogaster aggregata	Shiner surfperch	29	0.3
Unidentified rockfish	--	23	0.3
Trachurus symmetricus	Jack mackerel	22	0.2
Paralabrax clathratus	Kelp bass	20	0.2
Sphyraena argentea	California barracuda	17	0.2
Unidentified juvenile rockfish	--	16	0.2
Sebastes auriculatus	Brown rockfish	14	0.2
Sebastes serranoides	Olive rockfish	14	0.2
Sebastes atrovirens	Kelp rockfish	11	0.1
cf *Sebastes pinniger*	Canary rockfish	11	0.1
cf *Anterinopsis californiensis*	Jacksmelt	9	0.1
Sebastes paucispinis	Bocaccio	7	<0.1
Sebastes dallii	Calico rockfish	5	<0.1
Sebastes miniatus	Vermillion rockfish	5	<0.1
Scomber japonicus	Pacific mackerel	2	<0.1
Sebastes carnatus	Gopher rockfish	2	<0.1
cf *Chilara taylori*	Spotted cusk-eel	1	<0.1
cf *Sebastes chrysomelas*	Black-and-yellow rockfish	1	<0.1
Sebastes goodei	Chilipepper	1	<0.1
Pimelometopon pulchrrm	California sheephead	1	<0.1
Totals: 30 Taxa	--	8,930	100
Source: de Wit 1996.			

Fish observed on and around the shell mounds during the 1998 survey (de Wit 1999) included juvenile calico rockfish (*Sebastes dallii*) and the blackeye goby (*Coryphopterus* *nicholsii*). Abundance of both these species observed in 2000 was substantially reduced from the 1998 survey. De Wit (2001) reports that rockfish (*Sebastes auriculatus*, and an unidentified species) were present on the shell mounds, but were most common around the exposed pipelines and near the exposed leg stub at Hazel. The blackeye goby was also observed on the deeper-water shell mounds (Hilda, Heidi, and Hope). Table 3.3-1 presents relative abundance data for fish observed on the shell mounds two and four years after the platforms were removed.

3.3.1.2 Natural Habitats

The seafloor habitat within 0.5 miles (0.8 km) of the four shell mounds is predominantly soft bottom, characterized by de Wit (1999) as gently sloping, silty brown sediment. Underwater video of the "natural" seafloor within 100 feet (31 m) of the shell mounds indicates that sea pens (*Stylatula elongata*) and a cerianthid anemone (cf *Pachycerianthus* sp.) were common taxa (de Wit 1999). Sea pens were more abundant in far-field areas (more than 100 feet [33 m] from the shell mound perimeter), while abundance of cerianthids was relatively consistent in the near- and far-field areas (de Wit 1999). Sea pens typically require deeper sediment for retraction, so their higher abundance in far-field areas likely indicates deeper sediment further away from the influence of generally harder material comprising the mounds. That report also indicated that the bat star (*A. miniata*) and sea cucumbers (*Parastichopus* sp.) were present, but less common than sea pens and anemones in near-field areas. The bat star and cucumbers were also noted by Bomkamp et al. (2001) as less abundant on natural sedimentary bottom than on the shell mounds habitat. Common soft bottom fish within this depth range would include sanddabs (*Citharichthys* spp.), lizardfish (*Synodus lucioceps*), and various commercially important (e.g., California halibut) and non-commercial flatfish (see Section 3.5 of this document; for additional, but dated, background information, see Dames & Moore 1980).

Although offshore rocky features are relatively uncommon in the Channel, high-relief features approximately 1 mile (1.6 km) inshore (east-northeast) of the Hilda shell mound and 0.75 miles (1.2 km) inshore (northeast) of the Hazel mound are shown on nautical charts of the region. A larger, nearshore feature, Carpinteria Reef, is approximately 1.25 miles (2.0 km) northeast of the Hazel mound.

Features tentatively identified by Fugro as "rocky substrate targets" from 1998 side scan sonar records were not found during the 1998 ROV survey (de Wit 1999). The seafloor at those two locations was, however, characterized by numerous shallow depressions that likely produced side scan images similar to rocky features. The largest solid substrate feature was an area of boulders, approximately 65 feet (20 m) in diameter and approximately 1,500 feet (455 m) southeast of the Platform Heidi site. In addition to unidentified hydroids and bryozoans, that feature supported clusters of the solitary coral (*P. stearnsii*) (*C. bowersi*); *Paracyathus stearnsii* is solitary and tan to brown, compared to *C. bowersi*, which is colonial and light pink), strawberry anemone (*C. californica)*, and one colonial gorgonian (*L. chilensis*). Ten individual rockfish, representing three species (*S. dallii, S. auriculatus,* and *S. miniatus*), were observed in the water column immediately above and around the boulders (de Wit 1999).

3.3.1.3 Threatened and Endangered Species

The white (or Sorensen's) abalone, *Haliotis sorenseni*, is the only State or federal-listed threatened or endangered fish or invertebrate species that could occur in the project vicinity.[4] However, based on the apparent lack of appropriate habitat for algae, which serves as a principal food source for this and other abalone species, the shell mounds are unlikely to provide habitat for white abalone (pers. comm., Tom Napoli, CDFG 2003). Seven species of abalone, genus *Haliotis,* have been documented within southern California marine waters (Cox 1962; Haaker et al. 1986 and 2001; Howorth 1978). These species require rocky substrate and feed on drift algae, living kelp, and encrusting algae. Several species range from the intertidal zone into subtidal waters. These include the green abalone *(Haliotis fulgens)*, the red abalone *(Halitois rufescens)*, the pink or corrugated abalone *(Haliotis corrugata)*, and the black abalone *(Haliotis cracherodii).* A few species occur only in subtidal waters. These include the threaded abalone *(Haliotis kamschatkana assimilis)*, the flat abalone *(Haliotis wallalensis)*, and the white abalone (Cox 1962; Haaker et al. 1986 and 2001; Howorth 1978; Leet et al. 2001)*.* The deepest record for an abalone is 540 feet (165 m) for the red abalone (Cox 1962; Howorth 1978).

In a status review of white abalone prepared for NOAA Fisheries, Hobday and Tegner (2000) state that white abalone are usually reported to occur at depths of 66 to 200 feet (20 to 60 m), and to be most common at 80 to 100 feet (25 to 30 m). However, de Wit (2002) reports finding a single individual in 28 feet (8.5 m) of water off Las Flores Canyon, and historically, white abalone were found in shallower water throughout southern California (pers. comm., S. Anderson, USCB Marine Science Institute 2002). Cox (1962) reports that white abalone occurred at depths as shallow as 15 feet (4.6 m), and Howorth observed white abalone at this depth off Isla Vista, west of Santa Barbara (Howorth, unpublished field notes, 1962-2002). No white abalones have been reported on the rock substrate inshore from the mounds. Moreover, no species of any abalone have been reported on the shell mounds themselves, nor were any species of abalone reported on the platform jackets prior to removal (de Wit 1996, 1999 and 2001). Considering this and the lack of suitable substrate and food resources, white abalone is not expected to be affected by activities associated with the Program Alternatives.

3.3.2 Regulatory Setting

Impacts to marine biological resources or habitats would be addressed by the applicable State and federal agencies issuing permits for any removal or modification of shell mound materials. State agencies include the CSLC (modification of Abandonment Plan), RWQCB (section 401 certification and Wastewater Discharge Requirements), and CCC (Coastal Development Permit). Marine biological aspects of State permits are subject to review by the CDFG, which can recommend specific permit conditions or restrictions; presence of listed species would also trigger CDFG review pursuant to the

4 Due to low numbers, commercial fishing for all species of abalone ceased in the 1990s, and, in 2001, the white abalone was federally listed as an endangered species. The CDFG considers all species of abalone "sensitive."

California Endangered Species Act. Finally, the CDFG would need to be involved in any potential reef or offsite habitat restoration projects.

Federal agencies that could become involved in the permitting include the USACE (section 404 and section 10 permits for dredging or other work in waters of the U.S.) and the USEPA (ocean disposal and capping). NOAA Fisheries and the USFWS would be consulted by federal agencies during the permitting process on issues related to potential impacts to marine mammals, birds, and sea turtles. Formal involvement of NOAA Fisheries and/or USFWS could occur if there are potential impacts to “listed” species, thereby requiring a Section 7 consultation under the Federal Endangered Species Act. The USCG could also require that on-site activities be posted in the Local Notice to Mariners, and that any signage at the sites meet USCG requirements.

3.3.3 Significance Criteria

In general, adverse impacts to marine biological resources and the existing habitat(s) within the region and site could result from the following:

- Physical disturbance or habitat alteration during dredging, deposition of materials (e.g., capping sediments or reef materials), and anchoring and anchor line abrasion;
- Introduction of potentially toxic materials into the water column and onto the natural seafloor from sediment resuspended during jetting, blasting, dredging, or “smoothing” of the shell mounds;
- Discharge of contaminated water and/or sediments during dewatering operations;
- Oil spills from vessels and/or active pipelines that could be damaged during anchoring and/or removal operations; and
- Explosive demolition of the caissons.

Significant marine biological/habitat impacts are defined as those that:

- Substantially impact the biological communities associated with the seafloor beyond the footprint of the individual existing shell mounds;
- Adversely affect any State or federally listed species or alter their critical habitat(s);
- Substantially impact biologically significant habitat(s) (those listed as sensitive in local or state planning documents); or
- Result in substantial toxic effects to marine biota within the site or region.

As noted in Section 3.3.1, for this assessment, the “region” is defined as the seafloor and water column within a 0.5-mile (0.8 km) radius of the outer margin of the elevated, shell-covered mounds, and the “site” is the area of seafloor occupied by and including each mound.

3.3.4 Impacts and Mitigation Measures

The potential for impacts to marine benthic habitats, invertebrates, and fishes varies for each of the component actions and Program Alternatives identified in Table 1-1. The following sections address potential impacts associated with each Program Alternative. Each section begins with a description of the Program Alternative. Impacts are identified in summary tables, along with the location of the impact and impact class (defined in Section 3.0). Following each summary table, the impacts are described, measures to mitigate potentially significant adverse impacts are identified, and "residual impacts" (impacts following implementation of mitigation measures) are discussed. Less-than-significant impacts (Class III) and beneficial impacts (Class IV) are described where appropriate. Table 3.3-3, at the end of this Section, provides a summary of impacts, corresponding mitigation measures, and impact classes.

3.3.4.1 Program Alternative 1 (PA1): Shell Mounds and Caissons Removal and Disposal

PA1 involves the use of: (1) a barge-mounted, sealed clamshell bucket dredge to remove shell mound materials; (2) mechanical means and explosives to demolish the caissons at the Hazel site; (3) smoothing of the seafloor across each site with a "gorilla net" trawl to remove remnant materials; and (4) transport of the removed shell mound materials and caissons to LA-2 for offshore disposal, or to the POLB for transfer to an onshore disposal or reuse site. Barges would be moored at each site via a three-point or four-point anchoring system.

Program Alternative	*Impact #*	*Impact Description*	*Region/Location*	*Class*
PA1	**MB-1**	Removal of the 4H shell mounds would permanently remove contaminated sediments associated with the shell mounds from the marine environment.	Offshore Santa Barbara County (shell mound sites)	IV

Impacts: Permanent Removal of Contaminated Sediments

As discussed in section 3.2.4.1, removal of the shell mounds would eliminate risks of contaminant releases that could occur if the shell mounds were left in place and later disturbed by natural (e.g., storms, animal burrowing, subsidence) or human causes (e.g., trawling, anchoring). Specific impacts could include acute toxicity and contaminant bioaccumulation in bottom-dwelling organisms exposed to dispersed mound materials. Eliminating these risks is a beneficial (Class IV) impact.

Impacts of Removal Activities

Three impacts associated with removal activities are anticipated for PA1. These impacts (MB-2, MB-3, and MB-4) are discussed below.

Program Alternative	*Impact #*	*Impact Description*	*Region/Location*	*Class*
PA1	**MB-2**	Benthic organisms and their habitats will be physically disturbed (e.g., removed, crushed, or smothered with sediments) during operations associated with removing or modifying the shell mounds.	Offshore Santa Barbara County (shell mound sites)	III

Impact: MB-2

Similar to other dredging projects, PA1 would require the use of dredging equipment and vessel anchors that could crush or remove benthic habitats and biota, smother habitats and organisms with shifting sediments, and/or increase levels of suspended solids and turbidity that may foul feeding structures and gills. Potential impacts associated with contaminant releases are addressed in MB-3.

As discussed in Sections 3.3.1.1, while some organisms inhabit the shell mounds, the value of the mounds as habitat has decreased since the 4H Platforms were removed. Natural oceanographic processes are also causing sand and sediments to cover portions of the mounds, resulting in a decrease in available solid substrate; consequently, the value of the shell mounds as hard-substrate would further decrease. As discussed in Section 3.3.1.3, the shell mounds are unlikely habitat for any State or federally listed threatened or endangered species. Within one to three years after the shell mounds are removed, the underlying natural sedimentary seafloor is expected to support a biological community similar to that found at similar depths in the Channel.

Surveys indicate that the nearest hard-bottom features lie approximately .75 miles (1.2 km) inshore of the Hazel shell mound, 1 mile (1.6 km) inshore of the Hilda mound, and 1.25 miles (2.0 km) northeast of the Hazel mound (see Section 3.3.1.2). Previous analysis of deepwater sediment transport completed for the gas pipeline between Platforms Heritage and Harmony in ExxonMobil's Santa Ynez Unit (MMS 1997) indicated that fine sediments tend to settle out of the water column within 300 feet (91 m) of the point of disturbance. The silty sediments on and within the shell mounds are expected to follow this pattern, while the heavier-grained sediments within the shell mounds would be expected to settle to the seafloor at substantially closer distances (less than 300) feet. Thus, dredging is not expected to affect hard-bottom areas. The use of a sealed clamshell dredge (see MM WQ-2a) is expected to reduce the amount of material lost during dredging, thus further reducing turbidity, sediment resuspension, and impacts to habitat adjacent to the shell mounds.

In a conventional 3-point or 4-point mooring spread, anchor lines can extend a lateral distance of roughly 10 times the water depth. Anchor line drag can greatly increase the extent of bottom disturbance and impacts to hard-bottom habitat and immobile infauna. Given the depths at the four shell mound sites (Hazel, 96 feet [29 m]; Hilda, 106 feet [32m]; Hope, 137 feet [42 m]; and Heidi, 126 feet [38 m]), neither the anchors nor the anchor lines will affect known hard-bottom habitat in the region. However, impacts associated with scarring the seafloor could occur depending on how the anchors and anchor cables are placed.

Impacts associated with physical disturbance, including disturbance of organisms and loss of substrate, are expected to be localized, relatively short-term, and less than significant (Class III).

MITIGATION MEASURE(S) FOR IMPACT MB-2

MB-2a *At least thirty (30) days prior to the commencement of work, the Applicant shall submit to the California State Lands Commission for approval, and shall subsequently implement, an anchoring/mooring plan for work vessels at the site. The plan shall include best management practices to minimize disturbance of the seafloor and avoidance of sensitive features (including active oil pipelines as addressed pursuant to Impact MB-3). Measures shall include attaching a crown line leading to a spherical surface buoy to the head of each anchor; the crown line will be used to lower each anchor to, and pull each anchor from, the sea floor vertically with minimal disturbance*.

MMs WQ-2a and **WQ-2d** would also apply to Impact MB-2 (PA1).

RESIDUAL IMPACT(S)

Residual impacts would be less than significant (Class III).

Program Alternative	*Impact #*	*Impact Description*	*Region/Location*	*Class*
PA1	**MB-3**	Contaminants, including oil, released during project operations will disperse into the water column and onto the seafloor, resulting in toxicity and bioaccumulation during and for hours (water quality effects) to months (sediment effects) after the operations.	Offshore Santa Barbara County (shell mound sites)	II

Impact: MB-3

For PA1, soluble contaminants and petroleum hydrocarbons contained within the mounds would likely be released during dredging of the shell mounds, and possibly during decant water discharges. Continuing localized toxicity and bioaccumulation may also result from the dispersal of shell mounds sediments around the sites. As noted in Section 2.0, the sealed clamshell dredge is expected to reduce the amount of material lost during dredging; however, potentially significant impacts could occur from the uncontrolled deployment of the dredge onto the shell mounds and subsequent resuspension and deposition of contaminated sediments onto the natural seafloor. Oil could also be released from: (1) breakage by vessel anchors of an active oil pipeline that lies about 220 feet (67 m) from the Hope shell mound; and (2) accidental spills from project vessels. For example, as discussed under Impact MB-2, in a conventional

3-point or 4-point mooring spread, anchor lines can extend a lateral distance of roughly 10 times the water depth. Since the depth at the Hope site is approximately 137 feet (42 m), vessel anchors and anchor line drag could pose a risk to the pipeline.

As discussed in Section 3.2.4.1, sediment cores from each of the 4H shell mounds contained elevated concentrations of petroleum hydrocarbons and various metals, and PCBs were also present in sediments from three of the four shell mounds (AMEC 2002). Bioassay testing of the suspended particulate phase of the shell mound sediments did not cause significant toxicity to test animals, whereas testing of the solid phase caused significant toxicity. Additionally, test organisms exposed for 28 days to the shell mound cores exhibited significant bioaccumulation of PAHs and barium. The testing results suggest that the shell mound materials meet the USEPA's water column limiting permissible concentration (LPC), but would not be considered suitable for offshore disposal due to statistically significant solid phase toxicity.

Oil released into the water column during dredging operations and decant water from disposal barges could have toxic effects on marine biota in the water column. Effects of an oil spill could involve the loss of planktonic organisms, including larval fish within the water column and other organisms that are coated with substantial amounts of petroleum. Although much of the lighter fractions, generally considered to be the most toxic, would be expected to evaporate within a few hours of discharge, heavier petroleum compounds would remain in the seawater and/or be deposited on the seafloor where their effects would last for a longer period.

Impacts to benthic habitats, invertebrates and fishes are anticipated to be Class II because the extent of any toxic effects associated contaminant release can be reduced through mitigation measures to a very small area at the site.

MITIGATION MEASURE(S) FOR IMPACT MB-3

MMs WQ-2a through WQ-2e, and **WQ-3a** would apply to this impact.

RESIDUAL IMPACTS

As discussed in section 3.2.4.1, MMs WQ-2a through WQ-2d will ensure that concentrations of suspended sediments and associated contaminants, as well as hydrocarbons released from the shell mounds, are minimized in the vicinity of the operations. MM WQ-3a ensures the removal of contaminated sediments to the point that the risks of toxicity and bioaccumulation would be insignificant. The provision of oil spill containment and recovery equipment (MM WQ-2e) would help to limit the extent of oil releases if they occur. Implementation of an anchoring plan to document the location of the existing oil pipeline (MM MB-2a) would serve to minimize the potential for damage to the pipeline. Residual impacts would be less than significant (Class III).

Impacts of Transport and Disposal Activities

Two impacts associated with transport and disposal activities are anticipated for PA1. These impacts (MB-4 and MB-5) are discussed below.

Program Alternative	*Impact #*	*Impact Description*	*Region/Location*	*Class*
PA1	**MB-4**	Transport of materials may result in accidental spillage, or pose collision risks with other vessels that would cause spillage, thus adversely affect marine benthic habitats and biota. [Applies to transport of shell mounds materials and caissons' components.]	At and en route from the shell mound sites	I or II

Impact: MB-4

All Program Alternatives that result in the removal of the shell mound material and/or caissons would include transport and disposal of the collected material. Shell mound materials would be transported by barges and be disposed at either an existing USEPA-approved offshore site (e.g., LA-2) or, if the material is confirmed by USEPA and USACE to be unsuitable for ocean disposal based on the results of sediment testing, at an onshore site permitted to accept such material, after transport to the POLB (Figure 2.2-1).

As discussed previously, the release of shell mound materials could have toxic effects on marine biota. Marine biological impacts could occur from the effects of: (1) accidental loss of material into the marine environment during transport, and (2) toxic effects of the deposition of contaminated sediments at an offshore disposal site, if feasible based on chemical and toxicity testing results. Spillage of materials during transport could be caused by inadequate containment of the material, or by collisions with other vessels. The magnitude and class of impact would depend on the type of material (i.e., dredged sediments or caisson components) and the volume of materials spilled. For example, if large volumes of dredged materials that are unsuitable for ocean disposal were spilled or dumped in a single location, Class I impacts similar to Impacts CRF-8 and MB-7 (see below and Section 3.3) could occur if the spill could not be contained or cleaned up. Smaller spills could potentially be mitigated through proper containment of such materials so as to avoid incidental spillage (Class II). Impacts to marine biota and habitats associated with a spill of removed caissons' components would be similar to those addressed in MB-1 (Class III).

MITIGATION MEASURE(S) FOR IMPACT MB-4

MB-4a *While in transit to and from the shell mounds sites, large vessels/barges engaged in transport or disposal activities shall remain within applicable vessel traffic lanes established by the U.S. Coast Guard.*

MB-4b *The Applicant shall ensure that all vessels, bins, and other equipment used to transport materials is capable of properly containing the materials so as to avoid spillage or other unauthorized discharges of the materials during transport, including equipping transport barges with passive monitoring systems that will track vessel locations and detect any losses of materials. The Applicant shall record the types and estimated volumes of materials to* *be transported both prior to departure of loaded vessels and upon offloading or disposal, and shall report any losses of materials to the California State Lands Commission within 24 hours of such loss. The Applicant shall be responsible for any cleanup costs resulting from an unauthorized discharge(s).*

RESIDUAL IMPACT(S)

With the use of established vessel traffic safety lanes as proposed, the possibility of accidental losses of the shell mound materials due to collisions during transit would be minimized and is considered less than significant. The use of real-time monitoring systems on the disposal vessels will allow detection of spills, and trigger corrective action for barging operations that fail to contain sediments. Residual impacts would be less than significant (Class III).

Program Alternative	*Impact #*	*Impact Description*	*Region/Location*	*Class*
PA1	**MB-5**	Ocean disposal of shell mounds sediments, if approved, would have potentially toxic effects on marine biota.	LA-2 (or other ocean disposal site)	I

Impact: MB-5

Based on the testing results indicating significant toxicity and bioaccumulation, disposal of the shell mounds sediments at the LA-2 site, if approved based on sediment testing results, would have significant effects on marine biota.

MITIGATION MEASURE(S) FOR IMPACT MB-5

None proposed.

RESIDUAL IMPACT(S)

The residual impact is significant and unmitigable (Class I).

Program Alternative	*Impact #*	*Impact Description*	*Region/Location*	*Class*
PA1	**MB-6**	Explosive demolition of the caissons at the Hazel site will result in the mortality of fishes and invertebrates in the immediate vicinity.	Offshore Santa Barbara County (Hazel shell mound site)	II

Impact: MB-6

Potential impacts to marine biological resources and habitats resulting from explosive demolition of the remnant Hazel caissons include: (1) sediment resuspension during diver excavation of shell mound material around the base of each caisson prior to placement and use of explosives; (2) high sound pressure levels generated by detonation of underwater explosives to remove the remnant caissons; and (3) loss of high-relief hard substrate that could be provided by the remnant structures when uncovered by the shell mound materials. These impacts are discussed below.

Sediment Resuspension. Bottom organisms (invertebrates and fish) may be adversely affected during excavation and “side casting” of sediments around the caissons, resulting in the resuspension and deposition of contaminated sediments into the water column and/or onto the natural seafloor, respectively. Since the majority of the shell material will have been removed prior to removing the remnant caissons at the Hazel site, these disturbances would be localized, short term, and less than significant (Class III).

Detonations. Based on underwater surveys conducted at the Hazel shell mound site over the past three years, the diversity and abundance of fish and macroinvertebrate fauna associated with the site have decreased substantially since the platform was removed. Prior to caisson removal activities, faunal abundance and diversity would be further reduced as a consequence of disturbance associated with the removal of the shell mound materials from above and around the caissons. This scenario is expected to contribute to a comparatively low fish loss caused by the use of explosives.

Appendix D presents a demolition strategy and includes background information on the expected effects of underwater explosions on fish and invertebrates, including a description of anticipated sound pressure levels that would result from explosive demolition of the caissons. This Appendix explains why certain types of fishes (those with swim bladders) are more vulnerable than other fishes or invertebrates, and discusses differences between the proposed caisson demolition and the previous removal of the 4H Platforms using explosives, such as use of smaller charges and creation of a sediment berm prior to blasting.

The actual numbers of individuals lost due to the effects of the detonations at Hazel cannot be accurately predicted. With the use of smaller charges, expected pressure reductions from the sediment berm, and the solid nature of the caissons, the impact of underwater explosives on the marine biota is expected to be localized and should result in relatively small numbers of fish and few macroinvertebrates being killed. The temporary presence of large aggregations of fish moving through the demolition site(s) could, however, result in a relatively large fish kill that would likely attract marine mammals and seabirds to the area and create a public nuisance. This is considered a significant but mitigable impact (Class II).

Loss of Hard Substrate Structures. The loss of the buried caissons is considered a Class III impact due to their low habitat value as noted previously. Program Alternative 5 evaluates augmenting the Hazel caissons with artificial reef materials, rather than removing the caissons, thus taking advantage of the vertical reef provided by the caissons.

MITIGATION MEASURE(S) FOR IMPACT MB-6

MB-6a *At least thirty (30) days prior to undertaking explosive demolition work, the Applicant shall submit to the California State Lands Commission for approval, in consultation the California Coastal Commission and Department of Fish and Game, and shall subsequently implement, an Explosives Use Plan. This Plan shall include a detailed explanation of the proposed demolition strategy with estimates of sound pressure levels that will be generated by the detonations, as well as a description of best management practices that will be employed to minimize fish kills and their secondary effects. Such practices shall include: provisions for detecting large aggregations of fish at the demolition site using sonar and/or on-site observers; delaying detonations if appropriate; and provisions for the immediate collection of killed fish at the surface and appropriate disposition (e.g., donation or onshore disposal).*

RESIDUAL IMPACT(S)

Residual impacts would be less than significant (Class III).

3.3.4.2 Program Alternative 2 (PA2): Leveling and Spreading of Shell Mounds with Caissons Removal and Disposal

PA2 involves the use of a standard clamshell dredge to spread or level most of the shell mound materials within an approximate 300 to 1,000 feet (91 to 305 m) radius area around each platform site. Spreading would result in deposition of approximately 1 foot (0.3 m) of shell mound materials over the natural sediments within this area. The remnant Hazel caissons would be removed and transported for disposal using methods previously described, and the smoothing of the material would be accomplished with a "gorilla net." Shell mound spreading and caisson removal proposed under PA2 would result in several of the same impacts as PA1, including MB-2, MB-3, MB-4 (in part) and MB-6.

However, Impact MB-2 (which acknowledges that shell mound removal would disturb benthic organisms and their substrate) cannot be feasibly mitigated under PA2. Physical disturbance of benthic organisms and their habitats (Impact MB-2) would be greater for PA2 than PA1, as a result of covering the natural sedimentary seafloor with up to 1 foot (0.3 m) of material. This is expected to result in the loss of some infauna and alter the character of habitat throughout an area of approximately 27 acres. In the absence of contamination, recovery to pre-spread conditions is estimated to require one to three years. Therefore, impact MB-2 would be a Class I impact under PA2.

Likewise, MB-3 could not feasibly be mitigated under PA2. Impacts associated with the releases of contaminants, including free petroleum, from the shell mounds during spreading (as identified under MB-3) are discussed at length in Section 3.2.4.2. The results of solid phase bioassay sediment tests conducted on the shell mound material suggest that the material does not meet ocean discharge criteria. Therefore, redistributing the material onto the natural seafloor is expected to expose existing infauna and epifauna to potential toxic effects as demonstrated by the aforementioned testing. The toxicity of shell mounds sediments appears to be due primarily to soluble hydrocarbons, which would become widely dispersed into the water column during spreading and recontouring. The analyses presented in Section 3.2.4.2 suggest that toxic effects would be limited to a roughly 27-acre zone representing the area of sediment dispersal. This is larger than what would occur during the dredging and transfer operations of PA1. In addition, as discussed in Section 3.2.4.2, chemical contamination and corresponding biological effects such as bioaccumulation that may result in long-term diminished productivity are likely to persist in the area of spreading. Therefore, MB-3 would be a Class I impact under PA2.

Dewatering, transport and disposal of shell mound materials are not proposed under PA2. Water quality impacts specific to PA2 include only the risk of vessel traffic collisions (part of WQ-4), with its associated water quality mitigation measure MM MB-4a (use of vessel traffic lanes). Demolition of the caissons by means of explosives and cuttings, plus removal, would occur as in PA1, with essentially the same impact (MB-6).

MITIGATION MEASURE(S) FOR IMPACT MB-2 AND MB-3 (PA2)

None proposed.

RESIDUAL IMPACT(S)

Residual impacts would be significant (Class I).

MITIGATION MEASURE(S) FOR IMPACT MB-4 (IN PART) AND MB-6 (PA2)

MMs MB-4a and **MB-6a** would apply to these impacts.

RESIDUAL IMPACT(S)

Residual impacts would be less than significant (Class III).

3.3.4.3 Program Alternative 3 (PA3): Capping

PA3 would leave the existing shell mounds at their present locations, but they would be modified by placement of sandy material (a “cap”) on top of the mounds. Capping would require anchoring of vessels and would result in the complete covering of each shell mound and some natural seafloor beyond the existing perimeter of the mounds. The integrity of the cap would need to be monitored as described in Section 2.3. PA3 would result in some of the same impacts as PA1, including MB-2 and MB-4 (in part). These impacts would be significant but mitigable (Class II).

MITIGATION MEASURES FOR MB-2 AND MB-4 (IN PART)

MMs MB-2a and **MB-4a** would apply to this impact.

RESIDUAL IMPACT(S)

Residual impacts would be less than significant (Class III).

The following additional impact (MB-7) is applicable to PA3.

Program Alternative	*Impact #*	*Impact Description*	*Region/Location*	*Class*
PA3	**MB-7**	Deposition of the capping material or damage to the cap may resuspend sediments and have toxic effects on marine biota.	Offshore Santa Barbara County (shell mound sites)	II

Impact: MB-7

Class II impacts to the marine biological resources could result from the resuspension of contaminated shell mound sediments if capping material is deposited in an uncontrolled manner. The introduction of large volumes of shell mound material into the water column and settlement onto the surrounding seafloor could result in potentially significant effects to biota due to the toxicity of the material.

Erosion or loss of the cap could be caused by a resumption of bottom trawling on the site, anchoring, biological activity, currents, and/or seismic events. These circumstances cannot be readily predicted or addressed through design of the cap, and restrictions on trawling or other types of fishing would be inconsistent with the purpose of the cap. The loss of the cap itself would not have significant impacts, but it would increase the risk of deeper erosion that could cause the release of contaminants from the shell mounds. This impact is considered significant but mitigable through the replacement of capping material as needed (Class II).

The deposition of capping material over the mounds with a 4 to 6 percent slope, would affect an approximately circular area about 1,500 feet (450 m) in diameter at each of the mounds, resulting in a total buried area of about 40 acres at each mound or 160 acres total. There would be a gradual recolonization of the buried area over the course of one to three years, during which time benthic productivity and bottom-fishing opportunities may be diminished relative to existing conditions. Periodic replenishment of the cap, if needed, would also impact benthic productivity and fishing opportunities, but presumably on a smaller scale since only part of the cap would likely need repair. Although details on the grain size of the capping material are not known, it is likely that it would be sandier than the surrounding natural sediments, thus resulting in initial development of an infaunal community that would be somewhat different than that found on the existing natural seafloor. Subsequent deposition of natural sediments onto the cap material is expected to result in the eventual development of a biological community that is more similar to that occurring on and in the existing natural seafloor. Overall, the impact is considered adverse but less than significant (Class III). A potential beneficial effect of capping is the further isolation of contaminated material within the shell mounds by the capping materials.

MITIGATION MEASURE(S) FOR IMPACT MB-7

MMs WQ-7a, WQ-8a, and **WQ-9a** would apply to this impact.

RESIDUAL IMPACT(S)

Residual impacts, including the effects of turbidity incidental to the placement of the reef, would be less than significant (Class III).

3.3.4.4 Program Alternative 4 (PA4): Artificial Reefs at all Four Shell Mounds

PA4 would leave the shell mounds at their present locations, but they would be enhanced with CDFG-approved hard substrate to create artificial reefs. The enhancement alternative would consist of placing a two-tiered "ring" of 3 feet (~1 m) diameter, quarried armor-type rock around the perimeter of each of the four shell mounds; the single remnant leg stub at the Hazel site would remain in place. The resulting 6 feet of vertical relief would provide hard substrate upon which epibiota could attach and voids that would be conducive to supporting cryptic fish and invertebrates. As discussed in Section 2.3, additional structures, such as hollow concrete "reef balls" (pers. comm., T. Raftican, United Anglers), could be added to the mounds to augment the amount of hard substrate and increase the vertical relief of the mounds.

PA4 would result in some of the same impacts as PA1, including MB-2, MB-3, and MB-4 (in part), and the associated mitigation measures would apply. MB-2, which concerns the physical disturbance of benthic organisms and their habitat, would be mitigated down to a Class III impact (as opposed to Class II under PA 1) since reef creation would ultimately benefit these resources.

Impacts would result from the transport and placement of the reef materials. However, since dewatering and transport of shell mounds materials or caissons are not components of PA4, impacts specific to these activities would not occur.

The following additional impacts (MB-8 and MB-9) are applicable to PA4.

Program Alternative	*Impact #*	*Impact Description*	*Region/Location*	*Class*
PA4	**MB-8**	Deposition of quarry rock or other reef materials on top of the shell mounds may damage the mounds resulting in resuspension of sediments and toxic effects on marine biota.	Offshore Santa Barbara County (shell mound sites)	II

Impact: MB-8

Class II impacts to marine biological resources and existing habitats could occur from the resuspension of contaminated shell mound sediments during placement of the armor rock and other reef materials, if the reef materials are deposited in an uncontrolled manner. The introduction of large volumes of shell mound material into the water column and settlement onto the surrounding seafloor could result in potentially significant (Class II) effects to biota due to the toxicity of the material. In contrast, as discussed in Section 3.2.4.4, deposition of the reef rocks *around* each of the mounds is expected to have insignificant (Class III) effects on the dispersal of shell mounds sediments and associated contaminants. Consequently impacts on marine biological communities could be controlled through careful placement of reef materials.

MITIGATION MEASURE(S) FOR IMPACT MB-8

MMs WQ-10a, WQ-10b, and **WQ-11a** would apply to this impact.

RESIDUAL IMPACT(S)

As discussed in Section 3.2.4.3, these measures would allow for accurate placement of reef materials while avoiding damage to the shell mounds; and for the detection and repair of damage to the mounds before the possibility of contaminant releases. Residual impacts are less than significant (Class III).

Program Alternative	*Impact #*	*Impact Description*	*Region/Location*	*Class*
PA4	**MB-9**	There would be permanent replacement of natural seafloor habitat with the shell mounds, resulting in a continuing risk of contaminant releases that would have potential toxicity and bioaccumulation effects on biota residing onsite.	Offshore Santa Barbara County (shell mound sites)	II

Impact: MB-9

The addition of high-relief, hard substrate is expected to result in some potential beneficial impacts by increasing the amount of locally limited hard substrate, but ultimately resulting in an increase in biological diversity compared to that which currently exists at the shell mounds. De Wit (1999) reported that fish and invertebrate communities associated with a boulder-type habitat located approximately 1,500 feet (455 m) southeast of the Heidi site, differed substantially from that found at the shell mound in similar water depths. Based on the size of the sea fans (gorgonians) at the boulder habitat, that report suggested the rock had been in place for at least ten years. It is expected that within three to five years, the epibiota community potentially developing on the armor rock would be similar to deeper portions of the submerged platforms prior to their removal. Assuming that 50 percent of the bottom layer rocks and 100 percent of the top layer rocks are exposed, the “reef” would add an estimated 1 acre (4,180 m^2) of solid substrate surface area to each shell mound (4 acres total). Fish diversity would also be expected to increase and the rock would provide suitable habitat for cryptic macrobiota including rock crabs. Although relatively limited in surface area compared to the rock, the single exposed remnant leg stub at the Hazel site would provide additional solid, vertical relief substrate.

The new perimeter reefs may also protect the shell mounds from future disturbance. However, if the integrity of the shell mounds were to be compromised, there would be a risk of contaminant releases that could expose resident biota to toxicity and chronic bioaccumulation effects, potentially negating the habitat value of the hard substrate (Class II).

MITIGATION MEASURE(S) FOR IMPACT MB-9

MB-9a *To offset the permanent replacement of 4 acres of native seafloor habitat by the shell mounds (not including the artificial reefs), the Applicant shall create or restore an equal area of fisheries habitat by funding existing estuarine habitat restoration at Carpinteria Marsh.*

RESIDUAL IMPACT(S)

Residual impacts would be less than significant (Class III).

3.3.4.5 Program Alternative 5 (PA5): Artificial Reef at Hazel after Removing (5a) or Spreading (5b) Shell Mounds

Under PA5, an artificial reef would be constructed at the Hazel site only, after the shell mounds were removed. This Program Alternative, which eliminates the need to remove the caissons and transport and dispose of the caissons' components, would use the remnant caissons as the cornerstones of the reef. Quarry rock of the same dimensions as used for PA4 would be used to fill in the structure of the reef between and around the caissons, resulting in an artificial reef of about one acre. As with PA4, the structure of the reef could be augmented with other materials. The placement of a single relatively large reef at the Hazel site contrasts with the four relatively small reefs that would ring the shell mounds under PA4. There are two variants to PA5, depending on whether the shell mound materials are a) removed as under PA1; or b) spread as under PA2. Each is discussed separately below.

Program Alternative 5a (PA5a): Artificial Reef at Hazel Site plus Removal and Disposal of Shell Mounds

This Program Alternative would employ the same dredging and transport procedures as PA1, and would therefore have some of the same impacts and corresponding mitigation measures, including impacts MB-1 (Class IV), MB-2 (Class III), MB-3 (Class II), MB-4 (Class II), and MB-5 (Class I) if ocean disposal were to occur. PA5a would not result in the impacts specific to demolishing and transporting the caissons that were identified under PA1. PA5a would not have the same impacts as PA4 because contaminated sediments would be removed prior to reef construction. This resultant combination of PA1 and PA4 impacts similar to PA5a is summarized below.

MITIGATION MEASURES FOR PA5A

MMs MB-2a, WQ-2a through WQ-2e, WQ-3a, MB-4a and **MB-4b** would apply to this alternative.

RESIDUAL IMPACT(S)

Residual impacts would be less than significant (Class III), with the exception of ocean disposal of dredged shell mound materials if it occurred (Class I).

Program Alternative 5b (PA5b): Artificial Reef at Hazel Site plus Leveling and Spreading Shell Mounds

This alternative would employ the same procedures as PA2 and would therefore result in all of the same impacts (MB-2, MB-3, MB-4 (in part), MB-5, with the exception of MB-6, which would not occur (the Hazel caissons would remain).

MITIGATION MEASURES FOR PA5B

As noted previously in section 3.3.4.2, there is no feasible mitigation for the degradation of about 27 acres of benthic habitat that would occur with the spreading of the shell mounds materials.

MM MB-4a would also apply.

RESIDUAL IMPACT(S)

Residual impacts for MB-2 and MB-3 are significant (Class I). Residual impacts for MB-4 are less than significant (Class III).

3.3.4.6 Program Alternative 6 (PA6): Offsite Mitigation

Several off-site fisheries enhancement measures could be included with this Program Alternative as described in Section 2.7. These are more applicable to commercial and recreational fishing and are considered in Section 3.5. The primary impact to marine benthic habitat, invertebrates, and fishes associated with PA6 is similar to Impact MB-9 discussed under PA4, above.

According to de Wit (1999, 2001), the macrobiota and fish associated with the shell mounds have decreased in abundance and diversity since the platforms have been removed, and natural sedimentation appears to have covered much of the surficial shell material. The value of the shell mounds as a high-relief solid substrate habitat also appears to have decreased since platform removal and the elimination of the source of bivalve and other living material onto the mounds. The study by Bomkamp et al. (2001) indicated the presence of both hard- and soft-bottom fishes and macroinvertebrates, but suggested that the community will continue to decline in diversity and productivity over time. Deposition of sediment is expected to continue and ultimately result in the covering of the shells, thus removing attachment substrate for many epibiota. The single, exposed remnant leg stub at the Hazel site would, however, continue to provide some limited value as a hard bottom feature where epibiota and reef-associated fish would occur, albeit in limited numbers due to the relatively small surface area provided by this feature.

Bioassay testing of the suspended particulate phase of the shell mound sediments did not cause significant toxicity to test animals, whereas testing of the solid phase caused significant toxicity. Additionally, test organisms exposed for 28 days to the shell mound cores exhibited significant bioaccumulation of PAHs and barium. The testing results suggest that the shell mound materials meet the USEPA's water column limiting permissible concentration, but would not be considered suitable for offshore disposal due to statistically significant solid phase toxicity. That study and the Mussel Study together suggest that the some toxic contaminants remain within the shell mounds.

Similar to PA4, however, permanent coverage of the seafloor by contaminated sediments of the shell mounds warrants mitigation. At present, the evidence suggests that contaminated sediments within the shell mounds are not having adverse toxic or bioaccumulation effects on biota that reside on the shell mounds, and that contaminants are not being released into the water column, since the shell mound outer layers appear to be effectively 'capping' the contaminants. Contaminants could be released, leading to localized toxicity and bioaccumulation if the mounds were substantially eroded or disturbed by anchors, nets, or other means. These effects would be detectable through monitoring, and could be corrected through capping or removal of the eroding material.

MITIGATION MEASURE(S) FOR IMPACT MB-9 (PA6)

MM MB-9a would apply to this impact.

RESIDUAL IMPACT(S)

MM MB-9a provides a 1:1 replacement ratio, using shallow marine-estuarine habitat at Carpinteria Marsh to offset the permanent coverage of natural seafloor habitat at the shell mounds sites. Residual impacts would be less than significant (Class III).

3.3.4.7 No Project Alternative

Under the No Project Alternative, the Shell Mounds would be left in place and no on- or offsite mitigation measures would be implemented. As such, there would be a continuation of the following impacts as discussed in previous sections:

1. Permanent loss of four acres of natural seafloor habitat.
2. Ongoing risk of contaminant releases from the shell mounds if the mounds are damaged.

Table 3.3-3. Summary Matrix of Potential Impacts to Marine Benthic Habitats, Invertebrates, and Fishes Associated with Program Alternatives

Program Alternative	*Impact #*	*Potential Impact*	*Impact Class*	*Mitigation Measures*
PA1	MB-1	Removal of the 4H shell mounds would permanently remove contaminated sediments associated with the shell mounds from the marine environment.	IV	*None proposed.*
	MB-2	Physical disturbance of benthic organisms and their habitats during shell mound removal or modification operations.	III	*MM MB-2a. Submittal to the California State Lands Commission for approval, implementation of anchoring/mooring plan to minimize disturbance of the seafloor and avoidance of sensitive features.* *MMs WQ-2a and WQ-2d would also apply*
	MB-3	Contaminants, including oil, released during project operations will disperse into the water column and onto the seafloor, resulting in toxicity and bioaccumulation during and for hours (water quality effects) to months (sediment effects) after the operations.	II	*MMs WQ-2a through WQ-2e* *MM WQ-3a*
	MB-4	Transport of materials may result in accidental spillage, or pose collision risks with other vessels that would cause spillage, thus adversely affect marine benthic habitats and biota. [Applies to transport of shell mounds materials and caissons' components.]	I or II	*MM MB-4a. Large vessels/barges engaged in transport or disposal shall remain within established vessel traffic lanes while in transit.* *MM MB-4b. Vessels, bins, and other equipment used for transport to be adequately equipped to contain materials and avoid unauthorized discharges. Applicant to record materials transported, report loses to the California State Lands Commission. Applicant responsible for unauthorized discharges.*

Table 3.3-3. Summary Matrix of Potential Impacts to Marine Benthic Habitats, Invertebrates, and Fishes Associated with Program Alternatives (continued)

Program Alternative	*Impact #*	*Potential Impact*	*Impact Class*	*Mitigation Measures*
	MB-5	Ocean disposal of shell mounds sediments, if approved, would have potentially toxic effects on marine biota.	I	*None proposed.*
	MB-6	Explosive demolition of the caissons at the Hazel site will result in the mortality of fishes and invertebrates in the immediate vicinity.	II	*MM MB-6a. The Applicant shall submit to the California State Lands Commission for approval, in consultation the California Coastal Commission and Department of Fish and Game, and shall subsequently implement, an Explosives Use Plan.*
PA2		MB-2	I	*None proposed.*
		MB-3	I	*None proposed.*
		MB-4	II	*MM MB-4a and MB-6a*
		MB-6	II	*MM MB-4a and MB-6a*
PA3		MB-2	II	*MM MB-2a and MB-4a*
		MB-4	II	*MM MB-2a and MB-4a*
	MB-7	Deposition of the capping material or damage to the cap may resuspend sediments and have toxic effects on marine biota.	II	*MM WQ-7a* *MM WQ-8a* *MM WQ-9a*
PA4		MB-2	III	*MM MB-2a and WQ-2a and –2d*
		MB-3	II	*See MMs WQ-2a through -2e, WQ-3a, and MB-4a*
		MB-4	II	*MM MB-4a and –4b*
	MB-8	Deposition of quarry rock or other reef materials on top of the shell mounds may damage the mounds resulting in resuspension of sediments and toxic effects on marine biota.	II	*MM WQ-10a* *MM WQ-10b* *MM WQ-11a*

Table 3.3-3. Summary Matrix of Potential Impacts to Marine Benthic Habitats, Invertebrates, and Fishes Associated with Program Alternatives (continued)

Program Alternative	*Impact #*	*Potential Impact*	*Impact Class*	*Mitigation Measures*
	MB-9	There would be permanent replacement of natural seafloor habitat with the shell mounds, resulting in a continuing risk of contaminant releases that would have potential toxicity and bioaccumulation effects on biota residing onsite.	II	*MM MB-9a. To offset the permanent replacement of 4 acres of native seafloor habitat by the shell mounds (not including the artificial reefs), the Applicant shall create or restore an equal area of fisheries habitat by funding existing estuarine habitat restoration at Carpinteria Marsh.*
PA5a		MB-1	IV	*None proposed.*
		MB-2	III	*MM MB-2a and WQ-2a and –2d*
		MB-3	II	*See MMs WQ-2a through -2e, WQ-3a, and MB-4a*
		MB-4	II	*See MM MB-4a and 4b*
		MB-5	I	*None proposed.*
PA5b		MB-2	I	*None proposed.*
		MB-3	I	*None proposed.*
		MB-4	II	*See MM MB-4a*
		MB-5	I	*None proposed.*
PA6		MB-9	II	*MM MB-9a*